Mutton, beef, and sheep's kidney showed no lithium: one kidney had a slight trace.

### Conclusions.

1. *On the Rate of Passage of Solutions of Lithium into the Textures of Animals.*

Chloride of lithium taken into the stomach in quantities varying from one quarter of a grain to three grains, will pass into all the vascular parts of the body, and even into the non-vascular textures, in from one quarter of an hour to five hours and a half.

2. *On the Rate of Passage out of the Textures of Animals.*

Chloride of lithium passes out by the skin as well as by the urine; and thus the animals can redose themselves with chloride of lithium from the hair and feet, and prevent accurate observations. Hence probably chloride of lithium, in quantities varying from half a grain to three grains, will continue to pass out of the body for thirty-seven, thirty-eight, or thirty-nine days; and even after thirty-three days, traces may be found in the lens; but in three or four days no lithium may be detectable in the non-vascular textures.

3. In man, carbonate of lithia, when taken in five- or ten-grain doses, may appear in the urine in five to ten minutes if the stomach is empty, or twenty minutes if the stomach is full, and may continue to pass out for six, seven, or eight days.

In two hours and a half, traces may be in the crystalline lens, and in five or seven hours it may be present in every particle of the lens and in the cartilages. In thirty-six hours it may be very evident in the cartilages. And in seven days not the slightest trace may be detectable in the crystalline lens.

4. Though in the solid and liquid food infinitesimal quantities of lithium may enter the body, usually no proof of their presence in the organs or secretions can be obtained.

## IV. "Lunar Influence on Temperature." By J. Park Harrison, Esq., M.A. Communicated by the Rev. R. Main, F.R.S. Received April 27, 1865.

The tabulation of an unbroken series of thermometric observations for the several days of the lunation during fifty years having been completed up to November 1864, and an amount of lunar action detected which appears sufficient to set at rest the long vexed question of the moon's influence over our atmosphere, I venture to think that the time has arrived when it becomes a duty to lay the results of the investigation before the Royal Society.

In 1856 the frequent recurrence of higher temperatures about the eighth or ninth day of the moon's age, led to an examination and comparison of the mean temperatures of the third day before, and the second day after first quarter of the moon, for a series of seven years at Chiswick, and sixteen years at Dublin. The results showed conclusively that the temperature of the second day after first quarter was higher than the temperature of the third day before that phase during the years in question.

On extending the investigation to the remaining days of the lunation, the maximum was found to occur, at both stations, at the period when heat was first observed, and the minimum after full moon and last quarter.

The long series of mean temperatures which had been determined by Mr. Glaisher for the British Meteorological Society from observations taken at Greenwich between 1814 and 1856, were next arranged in tables constructed for the purpose. These observations, though corrected by an arbitrary rule totally irrespective of the moon, and in a measure therefore eliminating influences that may have been exerted on the observed temperatures, appeared on the whole the best, as they were also the most extensive printed series existing.

*The method pursued.*—The Tables were constructed in the following manner:—The mean temperatures of the days on which the moon entered her four principal phases having been first inserted in columns arranged at equal distances, the mean temperatures of the first, second, and third days before and after each of the quarters were entered in the columns adjoining on either side; and any remaining observations in octant columns midway between the quarters*. The deficiency occasionally occurring in an equal number of six observations between the quarters, was supplied by repeating the observation of mean temperature of the third day after, or third day before the quarters, the same observation in such cases being used for both those days. Thus an equal number of observations was secured for twenty-eight days out of 29·5, at all the seasons of the year, a point of no little importance as regards the next process, viz., obtaining true means of the temperatures of the several days. This was done in the usual way, by adding together the observations of mean temperature in each column, and dividing the sums by the number of lunations the temperatures of which had been tabulated.

The last operation consisted in laying down the mean line on scale-paper, and marking above or below it the mean temperatures belonging to the several columns on vertical lines, representing the several days of the lunation preceding or following the four quarters. The points thus marked

* On an average, the number of observations in each of the octant columns equals half the number of observations in the other columns. Their means were not made use of in forming the curves of temperature.

on the scale-paper were united by straight lines, and thus formed what are usually termed "curves" of temperature.

*The results of the tabulation of the Greenwich observations.*—The tabulation of the mean temperatures of the 520 lunations between 1814 and 1856, resulted in the complete confirmation of the phenomenon originally observed; that is to say, the maximum mean temperature showed itself, as before, in the first half of the lunation, and the minimum mean temperature in the second half of the lunation. The difference between the maximum and minimum temperatures for the 520 lunations was 1° Fahr. (see Pl. V. fig. 1).

In the autumn of 1860 M. Faye communicated the above results to the French Academy*.

*Additional Results in* 1856–65.—The author has now the honour of laying before the Royal Society additional confirmatory evidence derived from a tabulation of mean temperatures at Greenwich for the eight years, or 99 lunations, which have elapsed since the year 1856†.

Upon examining the lunar curve of temperature derived from these means (see Pl. IV. fig. 2), the maximum mean temperature will be again found in the first half of the lunation, at the moon's first quarter, and the minimum mean temperature in the second half of the lunation. The difference is 3°·5; the maximum is 51°·7; and the minimum 48°·2. The mean of the period is 49°·56.

And on adding the sums of mean temperature of this period to the sums of the mean temperatures in the Table of 520 lunations, and dividing the sums of the several columns by 619 (the number of lunations which occur in fifty years), the maximum is still found to occur at the first quarter, and the minimum shortly after last quarter. The difference beween the maximum and minimum mean temperatures is 1°·33. A curve of the mean temperatures for the 619 lunations will be found in Pl. IV. fig. 1‡.

*Explanation of the Phenomenon.*—Although the recurrence of higher temperatures in the first half of the lunation, and more particularly at the moon's first quarter—as a meteorological fact—is not affected by the correctness or incorrectness of any explanation which may be given of the phenomenon, yet it will be well to state that a probable cause for the

* Comptes Rendus, December 1860.

† The Tables were laid before the Society, and are available for reference.

‡ As regards the annual sums of temperature of the two days of maximum and minimum, the sums on the former day are higher than the sums on the latter day in 34 years out of 50. And the sum of the differences, in the years in which the mean temperature of the day before first quarter is higher than the mean temperature of the second day after last quarter is 783°·6, whilst the sum of the differences, in the years in which the mean temperature of the former day is lower, is 220°·0. For several years together, however, the day of maximum temperature presents itself, not on the day before first quarter, but a day or two later (see Pl. V. figs. 2, 3, and note *ad fin.*).

apparent paradox of heat occurring at the moon's first quarter suggested itself in 1857*.

It was evident that the effects noticed could not be due to any heat derived directly from the moon. Even if the experiments of Melloni and Bouvard—and, it may be added, the results obtained by Professor Piazzi Smythe on Teneriffe—had not established it as a fact that no serviceable heat, dark or luminous, reaches the lower strata of the earth's atmosphere at the period of full moon, the results of the tabulation of mean temperatures at various stations and for different periods of time show that, with some remarkable exceptions to be hereafter accounted for, cold displays itself on the average in the *second* half of the lunation, and a higher temperature at first quarter—at the very time when it may be supposed that the moon has parted with the whole of the heat she has received from the sun, and her crust opposite the earth has not been subjected to the solar rays for a sufficiently long period for lunar radiant heat to exercise any thermal action, either direct or indirect, on our atmosphere.

This being so, the concurrent results of investigations undertaken by eminent physicists in this and other countries point to a maximum of cloud, rain, and vapour-bearing winds in the first half of the lunation, when the curves indicate heat †; and a minimum of cloud and rain, with drier winds, in the second half of the lunation. It was not difficult then to connect the two phenomena—all gardeners being practically aware of the fact that heat is retained in the soil by the agency of cloud ‡. Professor Tyndall has shown by his elaborate experiments, that this is the case also with respect to the aqueous vapour of the atmosphere.

*Whether the dispersion of Cloud is due to the Radiant heat of the Moon.*—As regards the degree of heat which is attained by the moon, Sir John Herschel estimates it as equal to the boiling-point of water; and the same eminent person considers that the radiation of this heat would be sufficient to disperse cloud in the upper regions of the air.

The estimate of the moon's heat appears to be that of our satellite at the period of opposition. But the maximum heat would not be attained until several days later; for, the moon always turning the same face to the earth, her crust directly opposite to us does not attain its greatest heat until last quarter, at which time not only will it have received the sun's rays for twice the number of days during which that surface had been heated at the time of opposition, but the adjoining region also (eastward of it), itself recently illuminated and heated for fourteen, thirteen, and twelve times the length of our day of twenty-four hours, although the sun's

* See Brit. Assoc. Reports, 1857, p. 248.

† The number of clear and cloudy days at Greenwich, during the seven years (1841–47) that bihourly observations were made at that station, also corresponds with the hot and cold periods at the station.

‡ See also Mr. Glaisher's paper on the subject in the Philosophical Transactions.

rays have passed from it, still radiates the heat that has been absorbed, and which it may be presumed has penetrated to a depth (according to the speed with which the moon is travelling) commensurate with the time of its exposure to the sun.

Again, as regards the date of the minimum temperature of the moon, doubtless the absence of all atmosphere must greatly augment the action of lunar radiation; yet it is impossible to believe that the flood of heat poured upon the moon day and night for so many days together, without intermission, can be speedily dissipated. It would be more consistent with the analogy of terrestrial meteorology that the state of cold in the moon should be prolonged beyond the renewal of the sun's radiation, and consequently no heat from her crust reach the limits of our atmosphere at first quarter.

It would be strictly according to analogy, also, if the length of time which the moon's surface-crust takes to attain its maximum heat were found to be greater than that which it takes in falling to its minimum. Now there appears some reason to believe that this is the case; and as the mean temperature of the year attains its maximum at Greenwich about the end of July (a considerable time after the summer solstice), and the day of minimum mean temperature occurs in the latter half of January (the intervals between the maximum and minimum, and the minimum and maximum, being as 5·5 to 6·5), so in the tables and curves of lunar temperature for forty-three and fifty years, a longer interval will be found between the day of maximum heat at the moon's first quarter and the day of minimum heat of the last quarter, than between the days of minimum and maximum. Assuming, then, that the earth and the moon absorb heat equally (due allowance being made for the alternate diurnal action of solar and terrestrial radiation in the case of the earth, and the prolonged bimonthly alternation of solar and lunar radiation in the case of the moon), if we consider the portion of the curve between the days of maximum and minimum as representing the period during which the temperature of the moon is increasing, and the portion of the curve between the days of minimum and maximum as the period during which the temperature of the moon is decreasing, the same causes operating in the case of both planets, there would appear to be actual evidence of similar effects.

*Exceptions accounted for.*—Whether, however, the moon clears the atmosphere by the agency of her radiant heat, or by thermo-electric currents, or by changing the direction of the winds (a phenomenon not unfrequently, perhaps, itself due to ascending currents caused by lunar radiation), the immediate cause of the phenomenon signalized by the curves would still seem to be the presence or absence of cloud and vapour in the higher regions of the air, and the exceptions to the rule of a period of cloud being on the average a period of heat would be owing to the varying positions of the sun, the moon, and the earth, or to the fact that the formation of

cloud and vapour is due to the sun and the winds, and not in any wise, as it would appear, to the moon, or, lastly, to that system of compensation and alternation which seems to obtain so frequently in atmospheric phenomena, and is so suggestive of mechanical force.

The exceptions to the rule of a higher temperature occurring at the moon's first quarter, and lower temperatures after full moon, in any single year or group of lunations, are not more frequent than occur during the annual march of the seasons, and affect the position of the mean hottest and coldest day in the solar year.

Several curves besides those referred to in the text are appended.

*Description of the Curves.*—Plate IV. fig. 1. Curve of mean temperature for 618 lunations (1814–65), from the Greenwich observations as corrected by Mr. Glaisher.

Fig. 2. Curve of mean temperature for 99 lunations (1856–64), from the same source.

Fig. 3. Curve of minimum temperature from the Greenwich observations for the same 99 lunations.

Fig. 4. Curve of mean temperature for three years, or 37 lunations (1859–61), at Oxford, from the photographic curves of temperature taken at the Radcliffe Observatory.

Fig. 5. Curve of mean temperature for the same three years as in fig. 4, from the ordinary means of the days at Greenwich, to compare with fig. 4.

Plate V. fig. 1. Curve * of mean temperature for 520 lunations (1814–56) at Greenwich.

Fig. 2. Curve of mean temperature for the 86 lunations (1841–47) during which bihourly observations were taken at Greenwich.

Fig. 3. Curve of mean temperature for 86 lunations (1837–43), from the Ordnance observations at Dublin.

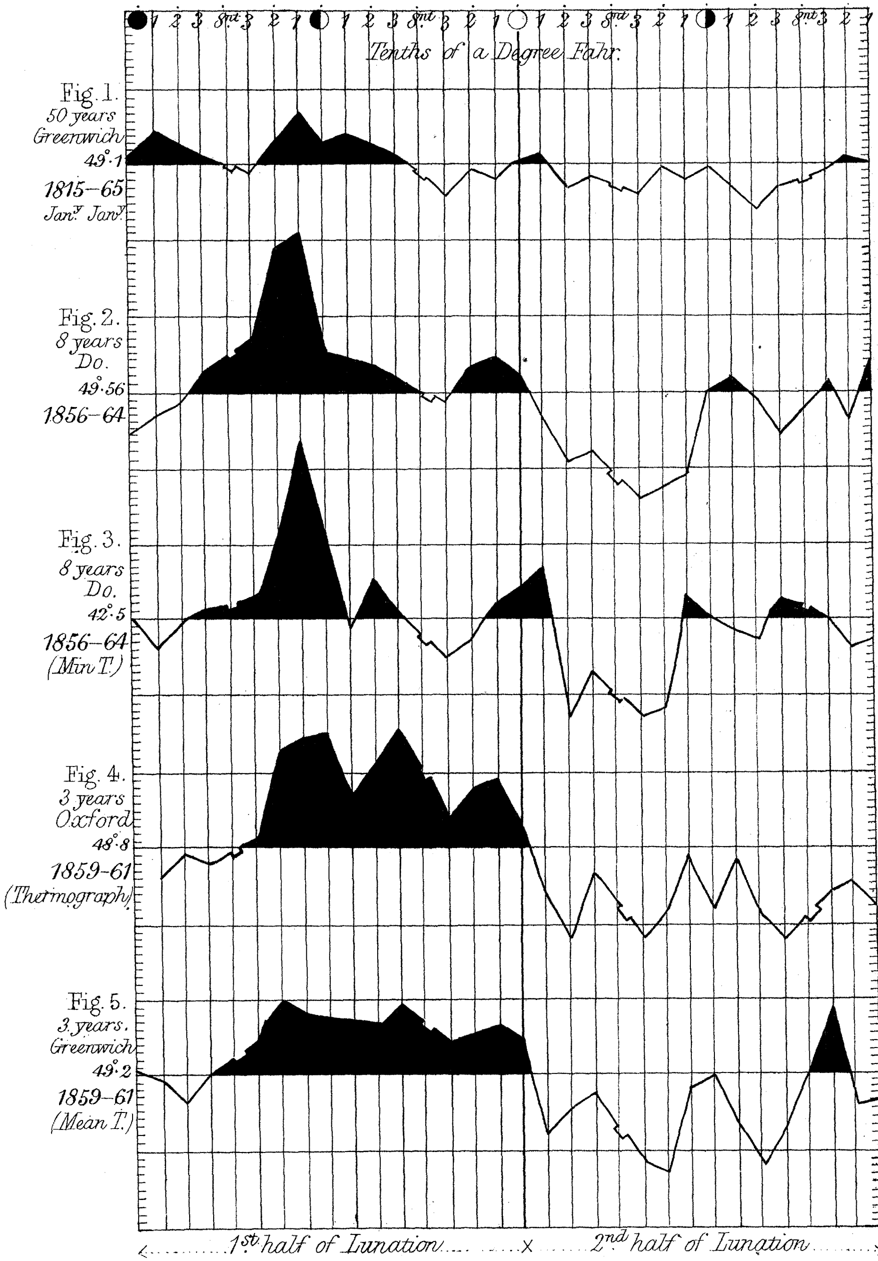
Fig. 4. Curve of mean temperature at Oust Sisolsk (Siberia), for 86 lunations (1837–43), to compare with fig. 3. (Mean of Russian observations at $18^h$, $2^h$, and $10^h$.)

Fig. 5. Curves of minimum temperature for one year (1859) at Greenwich and Utrecht.

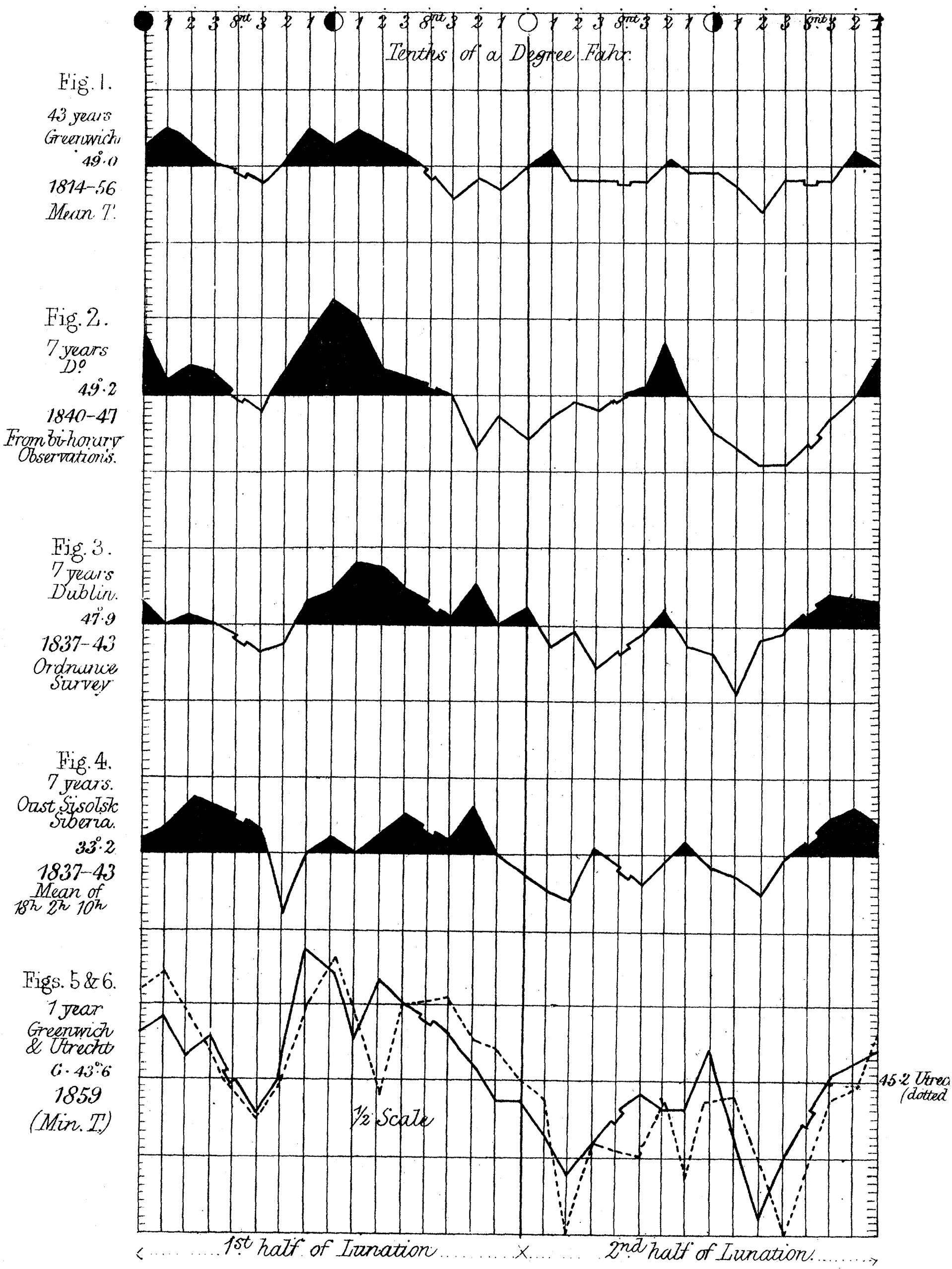
*Note.*—In 1848–56, the maximum occurred on the second day after first quarter, and a second maximum before last quarter. The minimum was found on the third day before first quarter, and the second minimum on the day before full moon.

* This curve appeared in the British Association Reports for 1859.

Plate IV. *Lunar Curves of Mean Temperature.*



# Plate V. *Lunar Curves of Mean Temperature.*

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